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AN EVALUATION OF TELEVISION PROCEDURES DESIGNED TO STIMULATE EXTRACURRICULAR SCIENCE ACTIVITIES. STUDIES IN TELEVISED INSTRUCTION, REPORT 6.

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A SERIES OF EXPERIMENTS WAS CONDUCTED TO TEST THE EFFECTIVENESS OF TELEVISED INSTRUCTION. THIS STUDY, THE SEVENTH IN A SERIES, EVALUATED THE EFFECTIVENESS OF THREE PROCEDURES TO STIMULATE STUDENT EXTRACURRICULAR SCIENCE ACTIVITIES. IN THE FIRST PROCEDURE THE PRESENTATION METHOD, ADULT INSTRUCTORS PERFORMED THE EXPERIMENTS IN ONE VERSION AND STUDENTS PERFORMED THE EXPERIMENTS IN ANOTHER VERSION. IN THE STUDENT-DEMONSTRATOR VERSION THE SECOND PROCEDURE WAS INTRODUCED. THREE EXPERIMENTS WERE PERFORMED TO COMPLETION AND ANOTHER THREE WERE BEGUN BUT CUT OFF BEFORE COMPLETION. FOLLOWING TELEVISED PRESENTATION, A THIRD PROCEDURE WAS INTRODUCED IN WHICH SOME CLASSES WERE PROVIDED WITH KITS AND INSTRUCTION TO ENABLE STUDENTS TO PERFORM THE EXPERIMENTS, AND STUDENTS IN OTHER CLASSES WERE GIVEN POSTCARDS OR ONLY INFORMATION SO THEY COULD WRITE IN FOR KITS. THE RESULTS WERE--(1) MORE STUDENTS WHO WATCHED FELLOW STUDENTS PERFORM EXPERIMENTS PERFORMED ON THEIR OWN THAN DID THOSE STUDENTS WHO WATCHED ADULT INSTRUCTORS, (2) THE MORE DIRECTLY AVAILABLE THE KITS WERE, THE MORE LIKELY STUDENTS WERE TO PERFORM AN EXPERIMENT, AND (3) THE COMPLETED EXPERIMENTS WERE NOMINATED AS ONES THE STUDENTS WANTED TO PERFORM MORE OFTEN. RELATED REPORTS ARE ED 003 646 THROUGH ED 003 653. (JC)

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The Metropolitan Pittsburgh
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STUDIES IN
TELEVISED INSTRUCTION

AN EVALUATION OF TELEVISION PROCEDURES DESIGNED TO STIMULATE EXTRACURRICULAR SCIENCE ACTIVITIES

6

PITTSBURGH, PENNSYLVANIA

AIR-C13-61-FR-245(VI)

STUDIES IN TELEVISED INSTRUCTION

Report Number 6

AN EVALUATION OF TELEVISION PROCEDURES DESIGNED TO STIMULATE EXTRACURRICULAR SCIENCE ACTIVITIES——

Studies in Televised Instruction, Report 6.

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Metropolitan Pittsburgh Educational Television Stations
WQED-WQEX

and

American Institute for Research
Pittsburgh, Pennsylvania

May 1961

OVERVIEW

This is one of a series of reports on studies that use student responses to improve televised instruction. In these studies student response was used in three different ways. All three kinds of use shared the common objective of utilizing student responses to provide tangible, measurable indications of the adequacy of instructional procedures for attaining the educational goals of TV lessons.

1. USE OF STUDENT RESPONSE

...To Pre-test a TV Lesson

Student responses on an achievement test following a preview showing of a TV lesson were used as a basis for preparing a revised version of the lesson. Student performance on each test question indicated which points were fairly well learned and which points were not. This information provided useful feedback to the TV instructor, guiding him in the preparation of a more effective revision of his lesson.

2. USE OF STUDENT RESPONSE

...To Evaluate "Programming" Adequacy

...To Enhance Learning Effectiveness

"Programming" techniques derived from research on self-instructional devices were applied in the preparation of TV lessons. A primary purpose of these techniques was to facilitate correct responses by students. Procedures were designed to elicit active responding throughout the lesson. Students' ability to respond correctly provided evidence of how adequately the lesson sequences were programmed. Also, when students were encouraged to make frequent active responses to lessons programmed so they could respond correctly, the effectiveness of the lessons was significantly increased. Student responding was thus used first, to indicate the adequacy of lesson programming and second, to increase lesson effectiveness.

3. USE OF STUDENT RESPONSE

...To Evaluate Incentive Created by a TV Lesson

A TV lesson was designed to stimulate student follow-up activity. Students were encouraged to perform experiments at home that they had seen demonstrated on TV. Student responses in performing experiments at home on their own indicated the effectiveness of the TV lesson in providing an incentive for follow-up activity.

Much of the responsibility for attaining the instructional objectives of a TV lesson rests with TV teachers and producers. Student responses can be considered as the building blocks of the program. This means devising instructional procedures that will elicit appropriate responses, and judging these procedures as adequate only when students do, in fact, respond appropriately. This kind of careful and systematic attention to student responses should contribute strongly to the successful attainment of educational objectives.

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The report presented in this volume illustrates the use of student responses to evaluate incentive created by a TV lesson.

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ABSTRACT

The purpose of this study has been to evaluate the effectiveness of three procedures designed to stimulate student extracurricular science activities. A "Fun Day" program was prepared to be shown within the context of a Junior High School science series presented to seventh and eighth graders. It consisted of six experiments that were judged relatively easy to do (for students) and which also required relatively simple and inexpensive equipment. The object of the study was to evaluate the effectiveness of three variables in stimulating students to perform one of the six experiments at home on their own.

One variable had to do with the method of presentation. In one version of the program, an adult instructor performed the six experiments, commented on the principle illustrated in the experiments, and encouraged students to try them out on their own. In a second version, students performed the experiments and the adult instructor (off stage) commented on the principles illustrated and encouraged students to try the experiments at home.

In the student-demonstrator version only, a second variable was introduced. This consisted of performing three experiments to completion. The three remaining experiments were begun but were cut off before completion. The purpose of this procedure was to determine whether students would be more stimulated to perform the incomplete experiments to find out what the results would be.

Following the telecast, a third variable was introduced. Some classes were provided with kits and instructions to enable students to perform the experiment they nominated as the one they most would like to perform. Students in other classes were given postcards and instructed that they could write in for a kit. Students in a third group of classes were given neither kit nor postcard, but were informed that they would receive a kit if they wrote in for one.

Results were as follows: (1) more students who watched fellow students perform experiments performed experiments on their own (84%) than did students who watched an adult instructor perform the same experiments (69%); (2) the more directly available kits were the more likely were students to perform an experiment

on their own (87% of those with kits performed experiments, as against 69% for those with postcards, and only 37% for those with no postcards); (3) more students nominated completed experiments as the ones they wanted to do than nominated an incomplete one (even though the reverse preference for the two specific sets of experiments was shown by control students who saw all of the experiments in completed form); and (4) the type of presentation they saw and how they were provided with materials needed to do experiments were also shown to have influenced students' attitude toward science. Techniques such as those employed in this study can stimulate extracurricular science activities by inducing students to perform experiments on their own. Use of student demonstrators to encourage their confidence in doing so and insuring ready availability of materials to facilitate the conduct of the experiments were shown to make an important contribution to this end.

INTRODUCTION

Extracurricular science activities can be essential elements in effective science education. Doing an experiment at home (or in school) following TV science lessons may both serve to enhance understanding of scientific principles and also to stimulate further interest in science (7). Performing an experiment at home can become a reinforcer for continued participation in science activities as well as an opportunity for learning from direct experience if the experiment is successfully completed. It is, therefore, important that the experiments demonstrated on the air be presented in such a way as to create an understanding of the principles involved. Since students are expected to follow the same procedures as those demonstrated on the air, it is also important that the presentation be such as to enable students to duplicate the details of the experiment. This means that conditions which will lead to effective "delayed imitation" need to be created (3 & 4).

Successful completion of an experiment at home may thus play an important role in influencing the student's understanding of and future interest in science. If this influence is to have an opportunity to be exerted, methods must be discovered that can effectively bring about initial student participation in extracurricular science activities. How is such initial participation to be brought about? What are the techniques and procedures that can effectively stimulate students to want to try experiments on their own at home? The purpose of the present study is to evaluate several techniques designed to stimulate students to perform experiments on their own that they have seen demonstrated during televised science lessons.

METHOD

The primary purpose of this experiment was to test the effectiveness of three procedures designed to stimulate students to engage in extracurricular science activities. These three procedures were incorporated in what was called a "Fun Day" program. This program was presented within the context of a year-long Junior High School science series transmitted on WQED-WQEX for seventh and eighth grade students in Western Pennsylvania. The "Fun Day" program consisted of six brief demonstrations of relatively easy experiments that students could be expected to perform on their own at home.

Development of experimental lessons

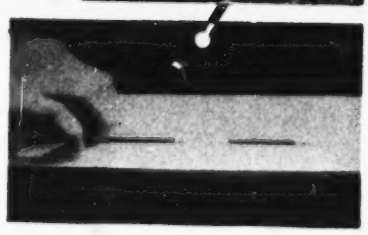
Six experiments were prepared for presentation on the program. Each experiment was intended to illustrate a principle of physical science or to illustrate a physical phenomenon. Relatively inexpensive equipment and materials were required to perform these experiments. The six experiments selected illustrated the following phenomena or principles: (a) magnetic lines of force; (b) surface tension in liquids; (c) Pascal's Law on the distribution of pressure; (d) compression and rarefaction of energy waves; (e) equalization of forces; and (f) transmission of light waves. Brief scripts were prepared carefully describing the experimental procedures to be followed and the principles being illustrated (see Appendix A). Following the preparation of the scripts and the materials needed for the demonstrations, experimental and control lessons were first rehearsed and then recorded for showing at a later date.

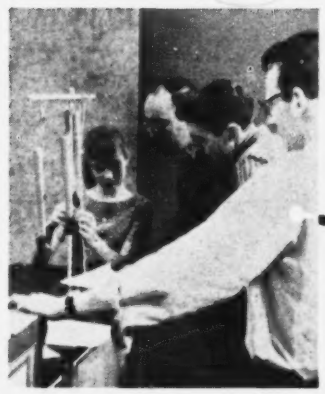
Experimental variables

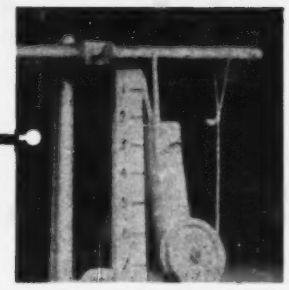
Three experimental variables were introduced in connection with the lesson. Two were incorporated within experimental and control lessons and one was implemented in classroom procedures that followed the telecast of the "Fun Day" program.

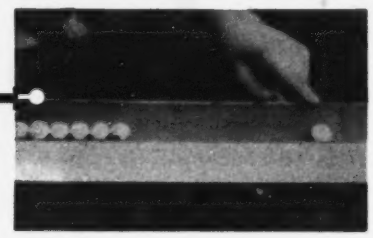
Variable Number 1: Student vs. adult demonstrator

In the control version of the "Fun Day" program, an adult teacher performed and described the six experiments. In the experimental version of the lesson, students of the same age as those watching the program performed the experiments while the off-stage teacher described the experiments. The scripts for the two









versions were virtually identical: both discussed the principles being exemplified and the details of the procedures being followed; both described the experiments as easy to do and urged students to try the experiments at home. One difference between the two scripts consisted of the teacher's reference in the experimental version to the "ability of students their own age" to perform the experiments. The figures appearing on pages 5 and 6 illustrate the preparation and production of some of the experiments performed and show either students or an adult demonstrator performing the experiments.

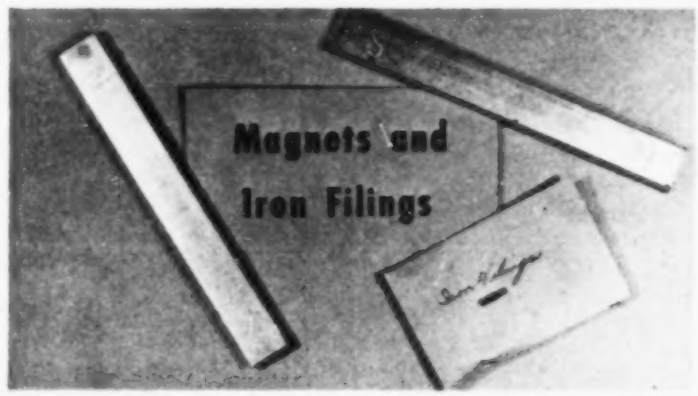
Variable Number 2: Complete vs. incomplete experiments

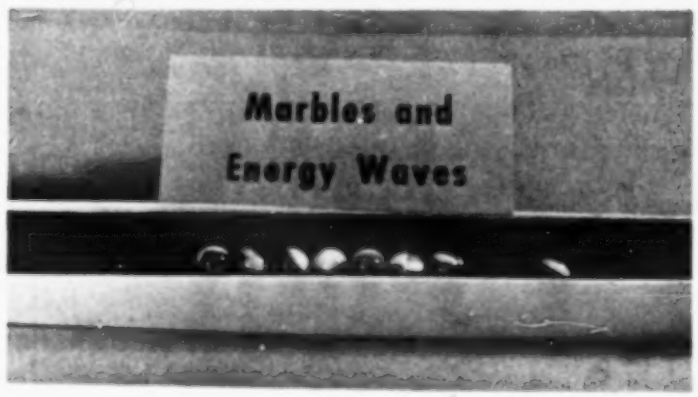
An additional variation was introduced into the experimental version of the lesson only. Three of the six experiments were presented as completed experiments with outcomes and results clearly described. The three remaining experiments were presented with only partial results shown. The commentary for these latter experiments suggested the possibility of slight variations in procedure. The question was then put to the viewing audience as to what the outcome might be following the slight variation or extension in procedure. The outcome for these three experiments was thus left "up in the air."

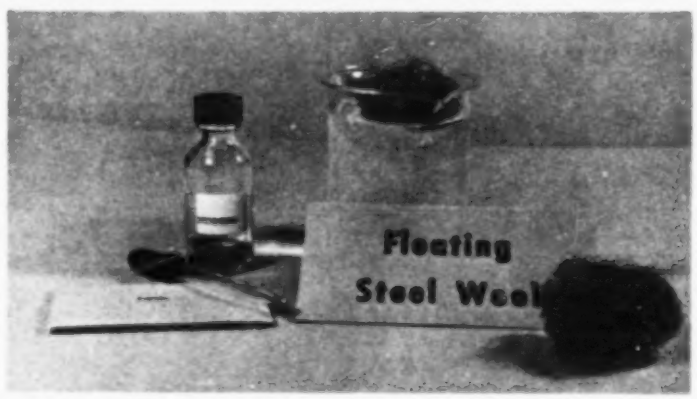
Variable Number 3: Ease of access to experimental materials

Following the telecast of the "Fun Day" program, students were asked to identify the one experiment which they would most like to try at home. Based on these nominations, kits with materials and instructions on how to perform each experiment were made available to students in one of three ways. In one set of schools, students were automatically given a kit for the experiment of their choice. In a second set of schools, students were given postcards addressed to the television station and were informed that they would receive a kit if they sent the postcard in. In a third set of schools, students were given neither kit nor postcard. They were informed, however, that if they sent in a postcard (which they would have to provide themselves) they would receive a kit. Variable number three thus had to do with differences in the direct availability of the wherewithal to perform experiments. The "kit" group had easiest access, the "postcard" group the next easiest and the "no postcard" group the least easy access to materials needed to perform the experiments. The figures on page 8 show the materials provided in each kit. Instructions on how to perform each experiment which accompanied each kit appear in Appendix C.

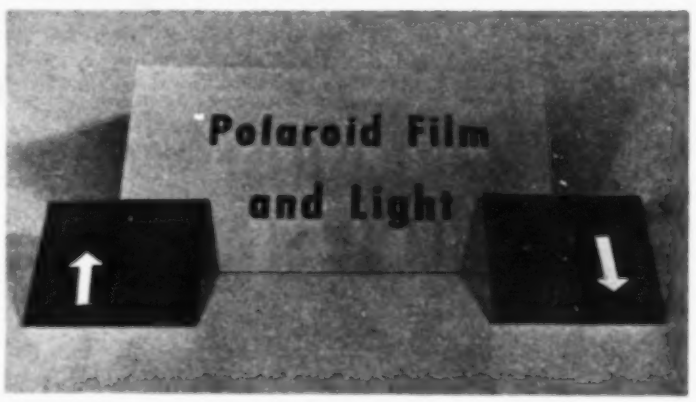
Hot Water
Bottle
and Air Pressure


Magnets and
Iron Filings


Marbles and
Energy Waves


Floating
Steel Wool

Hammer
and
Rubber Band


Polaroid Film
and Light

Procedure

Eight pairs of classes participated in the experiment. Since extracurricular activity following the telecast was the principal object of investigation, class rather than individual sampling was employed in this experiment to avoid possible interaction among students. Accordingly, one member of each of the eight pairs of classes was assigned intact to either experimental or control conditions and in the subsequent analysis each class, as a whole, was treated as the unit of observation rather than the individual student within the class (1).

Before viewing the telecast, all students filled out a questionnaire which was designed to measure their interest in or preference for science (see Appendix B). Following the telecast they filled out other questionnaires (see Appendix B) in which they nominated their favorite experiments. Based on these nominations, kits were made available to students as described above. Some students were routinely given a kit of their choice, others were given postcards they could use to send in for kits, and still others were given neither kit nor postcard but were informed that if they sent in for a kit they would receive one.

Approximately two weeks after the telecast a third questionnaire was administered to all students (see Appendix B). This questionnaire was designed primarily to determine whether students had performed one of the six experiments at home.

RESULTS

Questionnaries administered before, immediately after, and approximately two weeks after the telecast were analyzed to determine the effects on student attitudes toward science and on extracurricular activity that each of the three variables investigated had.

Separate questionnaries were administered to boys and girls to obtain a measure of their attitudes toward science. Items in the questionnarie allowed students to endorse one of a set of activities they would like to engage in and to nominate one of a set of occupations they would most like to pursue. Each set of items contained one science item and a total preference for science score was computed by summing all science items endorsed. Table 1 summarizes the analysis of variance for the difference in measured attitude toward science obtained before and after the experimental procedures.

Table 1

Analysis of Variance for
Change in Attitude Toward Science

	Mean Square	D.F.	F	P
Demonstrators (Experimental Variable #1)	58.43	1	5.78	.05*
Sex (of students)	9.95	1	.98	—
Materials (Experimental Variable #3)	140.63	2	13.92	.001***
IQ (of students)	15.23	1	1.51	—
Demonstrators x Sex	76.84	1	7.61	.01**
Demonstrators x Materials	20.48	2	2.03	—
Demonstrators x IQ	3.90	1	.39	—
Sex x Materials	5.89	2	.58	—
Sex x IQ	83.54	1	8.27	.01**
Materials x IQ	82.20	2	8.14	.01**
Demonstrators x Sex x Materials	4.92	2	.49	—
Demonstrators x Sex x IQ	1.52	1	.15	—
Demonstrators x Materials x IQ	6.48	2	.64	—
Sex x Materials x IQ	8.49	2	.84	—
Demonstrators x Sex x Materials x IQ	22.06	2	2.18	—
Within	10.10	32	—	—

*significance at the 5 percent level
**significance at the 1 percent level
***significance at the .1 percent level

To determine the possible interaction that there might be between such factors as IQ or the sex of students and the experimental variables under investigation, sub-groups within each class were formed based on these factors.[1] The relative influence of each factor in this analysis (e.g. demonstrators) and of interactions between the factors (e.g. demonstrators and sex of students) is indicated in the table by the variance ratios (F). The values given under the column labeled "P" indicate, as is usual, the statistical significance of the various sources of variance -- or, more specifically, the probability that a variance ratio as large as the one obtained would arise merely by chance.

Table 2 summarizes the analysis of variance for student reports of whether or not they performed experiments at home. Results given in Table 2 indicate total experimental activity by students without respect to <u>which</u> experiments students said they performed. (Results on specific experiments, related to variable number two, are discussed later in this report.)

Table 2

Analysis of Variance for
Student Reports about Performing an Experiment

	Mean Square	D.F.	F	P
Demonstrators (Experimental Variable #1)	3585	1	5.84	.05*
Sex (of students)	621	1	1.01	—
IQ (of students)	260	1	.42	—
Materials (Experimental Variable #2)	8140	2	13.26	.001***
Demonstrators x Sex	255	1	.42	—
Demonstrators x IQ	2174	1	3.54	—
Demonstrators x Materials	5761	2	9.38	.001***
Sex x IQ	335	1	.43	—
Sex x Materials	439	2	.71	—
IQ x Materials	111	2	.18	—
Demonstrators x Sex x IQ	2428	1	3.94	—
Demonstrators x Sex x Materials	2051	2	3.34	.05*
Demonstrators x IQ x Materials	68	2	.11	—
Sex x IQ x Materials	363	2	.55	—
Demonstrators x Sex x IQ x Materials	1010	2	1.64	—
Within	614	40	—	—

*significance at the 5 percent level
***significance at the .1 percent level

[1] Since classes were sampled rather than individuals, class measures were used as the units of measurement rather than individual scores in this analysis of variance and in subsequent analyses (1). Class measures for each sub-group were similarly used as the units of measurement.

Student demonstrators vs. adult demonstrator

The effect of the two different methods of presenting the "Fun Day" experiments on the air (student demonstrators vs. adult demonstrator) was revealed by changes in measured preference for science. As shown in Table 1, there was a significant difference between these two methods of presentation, but there was also a significant interaction between methods of presentation and the sex of students watching the program. An inspection of means reveals that, although students watching the adult demonstrator made a significantly higher increase in preference scores than did those watching the student demonstrators, this was true only for girls and not for boys. This is seen in a breakdown of the findings given in Table 3.

Table 3

Summary of Analysis of
Changes in Preference
(Demonstrators x Sex of Students)

	Mean Changes in Preference[2]	S.D.	Difference Between Mean Changes	t	D.F.	P
Boys						
Student Demonstrators	+1.9	4.7				
Adult Demonstrator	+1.6	5.0				
			0.3	0.3	13	.80
Girls						
Student Demonstrators	-1.3	3.4				
Adult Demonstrator	+3.1	3.6				
			4.4	3.7	13	.01**

**significance at the 1 percent level

The average improvement in preference for the girls watching the adult instructor as measured by the ratio of change in preference (3.1) to the maximum amount of change possible (16.2) was 19 percent.

As revealed in Table 2 based on student reports of whether or not they performed an experiment, there were also significant differences between methods

[2]Positive values represent an improvement or increase in "preference for science" scores.

of presentation. In this instance, however, more students were influenced by seeing fellow students perform experiments than were those who had seen the adult demonstrator perform the same experiment. Figure 1 illustrates the moderate but significant difference between students watching these two different methods of presentation.

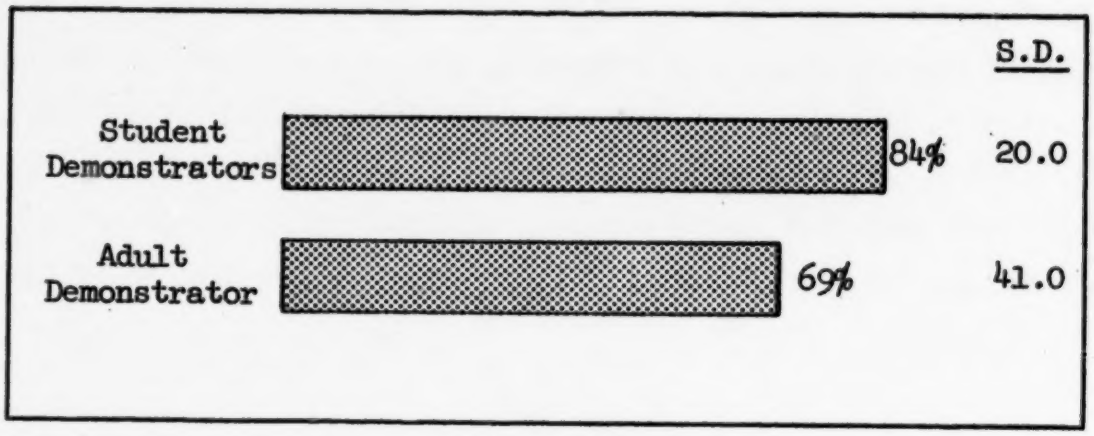


Figure 1

Mean Percentages of
Students Reporting Performance of an Experiment

Thus, seeing fellow students perform an experiment and being encouraged to do the same appears to have been a more direct and effective stimulus to student performance of similar experiments than it was to student (particularly girls) endorsement of questionnaire items reflecting interest in or preference for more varied or general science activities.

Kits vs. postcards vs. no postcards

Providing students either with kits or with a postcard with which to send in for a kit, resulted in an increased preference for science. Students who received neither kit nor postcard showed no improvement. Results in Table 1 indicate that the differences among the three groups were significant. Table 4 shows the mean changes in preference scores for all three groups.[2]

Table 4

Mean Changes in Preference Scores
for Students in the Kit, Postcard, and No Postcard Groups

	Mean Changes in Preference	S.D.
Kit	+1.44	3.0
Postcards	+4.23	5.0
No Postcard	-2.31	4.6

[2] ibid.

As shown in Table 2, there were also significant differences among the various methods of providing wherewithal with respect to the effect each had in stimulating student follow-up activity (performing an experiment). Figure 2 below shows the percentages of students in each group reporting that they had performed an experiment.

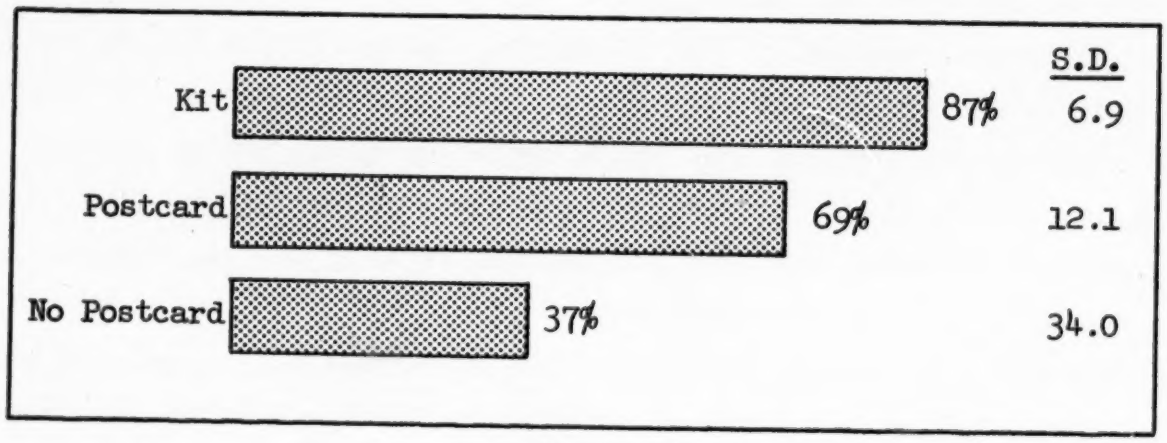


Figure 2

Mean Percentages in Each Materials Category
Reporting Performance of an Experiment

Further inspection of Table 2 reveals a significant interaction between methods of presentation (adult vs. student demonstrators) and type of wherewithal provided. The largest part of this variance was contributed by differences among students in the "No Kit" group. In this group, 80 percent of those watching the student demonstrators, as opposed to only 21 percent watching the adult demonstrator, reported doing an experiment. It would seem that the student demonstrators had their greatest impact where it was needed most, in the case of students not receiving any immediate "materials" inducement to perform an experiment. This influence was particularly strong for girls (100 percent of those who watched student demonstrators as against only 6 percent of those who watched the adult demonstrator reported doing an experiment). This influence was somewhat less strong for boys (60 percent as against 36 percent).

The over-all results appear, in general, to support the effectiveness of using student demonstrators to stimulate extracurricular science activities. They also indicate even greater effectiveness for the procedure of providing students with the wherewithal to perform experiments on their own at home. The more direct or immediate the wherewithal, the greater the benefit appears to be.

Complete vs. incomplete experiments

Following the telecast, students were asked to nominate the experiment they would most like to try. Six identical experiments had been seen by both the experimental group (student demonstrators) and the control group (adult demonstrator). In the experimental version only, three of the experiments (Experiments 2, 4, and 6) had been left incomplete. (The same three experiments were completed in the control version.) The odd-numbered experiments (1, 3, and 5) were seen in completed form by both experimental and control groups. Students watching the experimental version thus had a choice of doing one of the three completed experiments (1, 3 or 5) or of doing one of the three incomplete experiments (2, 4, or 6). Students watching the control version saw all six of the experiments in completed form, and they had the opportunity to select any of the same six experiments. The nominations of students who saw only completed experiments thus provide a relative measure of popularity for these "odd" and "even" groups of experiments (1, 3, 5 and 2, 4, 6).. Table 5 contrasts the difference in nominations of these two groups of experiments by experimental and control groups.

Table 5

Comparison of Nominations by Experimental and Control Groups of Two Sets of Experiments

	Among Students in the Experimental Group (Who Saw Completed and Incomplete Experiments):	Among Students in the Control Group (Who Saw Only Completed Experiments):
	56% reported doing experiments 1, 3, or 5 (Completed Experiments)	40% reported doing experiments 1, 3, or 5
	44% reported doing experiments 2, 4, or 6 (Incomplete Experiments)	60% reported doing experiments 2, 4, or 6
Difference=12%	in favor of completed (odd-numbered experiments)	20% in favor of even-numbered experiments

A chi-square analysis of the results in Table 5 produced a X^2 value of 8.71 which, for 1 D.F., is significant at the 1 percent level. Experiments 2, 4, and 6 which were seen as completed experiments by the control group, were selected by 60 percent of the students. The same three experiments seen in incomplete form by the experimental group were selected by only 44 percent of the students. These results may be interpreted to mean that leaving experiments incomplete appears to do little to stimulate interest in experiments and, in fact, may do the opposite.

DISCUSSION

Engaging in extracurricular science activities may be said to serve a dual function. It may, for example, help students to learn how to perform experiments, and it may also heighten future interest in science. In order to achieve either of these objectives, students must be prepared during the course of televised instruction and with the aid of instructions after telecasts to be able to perform experiments correctly. Correct performance can then be followed by reinforcement either in the form of correct results which the student recognizes himself or in the form of grades or evaluation he receives from teachers at school. The role of reinforcement is to strengthen the skills acquired in performing experiments as well as the knowledge or understanding acquired in particular experiments. Successful completion of experiments may also serve to stimulate interest in science in general and in performing other experiments.

A difficult problem that arises in televised instruction, as well as in classroom instruction, is how to generate initial interest or initial performance of an experiment which, when successfully completed, can be followed by reinforcement. The three techniques employed in this study were designed to meet this particular problem. Two of the three techniques apparently served the purpose for which they were employed.

Although relatively high proportions of students watching either the adult demonstrator or the student demonstrators actually went on to perform experiments on their own, those in the latter group were stimulated to do so to a significantly higher degree. Also, providing students with the wherewithal to do experiments appears to account for a large part of the success in stimulating students to do experiments at home. For those students to whom materials were not made directly available, however, seeing other students perform the same experiments was particularly effective in stimulating extracurricular activities. The impact of seeing fellow students of one's own age perform experiments appears to have been greatest for these students who received the least inducement by having been provided with neither the materials needed to do the experiments nor printed instructions on how to do them.

Providing needed materials and instructions was unusually effective in stimulating students to perform experiments. The more directly available or easily obtainable those materials were, the more successful the technique. The implications of these findings would appear to be that schools or school systems which wish to stimulate interest and achievement in science would do well to stock their laboratories with sufficient equipment and materials to allow students to engage in experiments on their own. The materials might be made available in conjunction with either television, teacher, or teaching-machine instruction. The direct availability of such materials appears to provide a strong and direct stimulus to respond (perform an experiment).

Prior demonstration of experiments and encouraging students about the relative ease of the experiments appears also to contribute to the success of the effort to stimulate follow-up activity. This may be particularly important for young people who may never have performed experiments on their own and who may have reservations about their ability to do so. Seeing other students, who are described as being their own age (and visibly so) and who are also described as being just like themselves successfully perform experiments seems to be effective in stimulating follow-up activity. This finding may be contrasted with earlier negative results on learning of science material in a comparison of expository off-stage narration with a film version which used student protagonists (2).

The third technique employed in this study appears to be ineffective. Leaving experiments incomplete appears to have an adverse effect as shown by the significantly smaller proportion of students selecting experiments which they saw as incomplete. Students of comparable age and ability who had seen the same experiments in a completed version, had indicated a higher preference for these experiments than for the remaining experiments performed during the program. This finding contrasts with that based on film studies where it was found that incomplete episodes from a film based on a novel were more effective inducements to read the novel than were completed episodes (5 & 6). It may be that students unfamiliar with the conduct of experiments may prefer to work with the known rather than with the unknown. Curiosity or anticipation built into a presentation would not seem to have much incentive value for students not very knowledgeable in the subject matter being presented.

It is suggested that a large part of the responsibility for stimulating student extracurricular activities rests with instructors. The techniques employed in this study are recommended to be used (along with others that are demonstrated to be effective) to prepare students to be able to perform experiments correctly and to want to do so.

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APPENDIX A

Lecture Materials

1. Script on "Fun Day" Experiments

   a. experimental lesson (student demonstrators) pp. A- 2 - A- 7
   b. control lesson (adult demonstrator) pp. A- 8 - A-13

FUN DAY

Script for Experimental Lesson
(Student Demonstrators)

Today we're going to show you six interesting experiments. The experiments are fun to do and easy enough to do yourself at home.

Here are some 7th and 8th grade boys and girls who regularly watch this science program. I'm going to explain each experiment and then the boys and girls here in the studio will show you how easy they are to do and how you can do them at home.

MAGNETS AND IRON FILINGS

Here is _____ holding a magnet. You have no doubt seen magnets such as this one, and know that they attract iron and steel. Magnets will not strongly attract anything which is not made of iron or steel. One end of the magnet is called the north pole and the other is called the south pole. If _____ brings the north pole of one magnet near another magnet it will attract the south pole of the other magnet. A force pulls the north pole and the south pole together. If _____ brings two north poles together or two south poles together, they will not attract each other. Instead, they will repel each other. That is, there will be a force between them pushing them apart. A basic principle of magnetism, then is this: like poles attract and unlike poles repel. Another principle is that the magnetism of a magnet is strongest at its poles and gets weaker and weaker as one moves nearer and nearer to the middle.

Let's put a piece of paper over a magnet. Let's sprinkle a thin layer of iron filings on it. Let's gently tap the paper. The iron filings arrange themselves in rows, stretching out from each pole. Notice also how these rows run from one pole to the other, along the sides. The iron filings arrange themselves in rows along the magnetic lines of force. The fact that the rows of iron filings run from the north pole to the south pole shows that magnetic lines of force connect these two poles.

Magnetic lines of force also connect unlike poles of two different magnets. We can show this by using two magnets, with the north pole of one facing the south pole of the other, like this. Now when we sprinkle iron filings on a piece of paper over two magnets with opposite poles close together we get a pattern like this.

Notice how the lines of force run from the north pole of the first magnet to the south pole of the other. Lines of force connect these poles because they are unlike and therefore attract each other.

Suppose we were to turn one of the magnets around so that the two poles facing each other are alike, this way.

What pattern will the iron filings show now? Will it be the same as before or different?

It is different. The magnetic lines of force go in the opposite direction and the iron filings follow these new magnetic lines of force.

You can try various combinations yourself at home to see how iron filings arrange themselves around magnets.

FLOATING STEEL WOOL

We all know that objects that are heavier than water will generally sink to the bottom when we put them in water. But have you ever seen anything heavier than water float on the surface of the water? Here's a razor blade floating on the surface -- right on top of the water. The razor blade is heavier than water. How can it float right on top this way? What is the explanation?

We can go back to some of the ideas we learned about the make-up of matter. Remember that all matter is made up of molecules which are attracted to one another. Liquids, solids, and gases are all made up of molecules which are held together.

The molecules in the water in this beaker are held together very strongly. The attraction among the water molecules at the surface is so strong that it's almost as if a thin film were spread along the surface. This thin film at this surface acts as if it were under tension. We call this <u>surface tension</u>. It is the surface tension of the water that allows the razor blade to float on the surface. It's almost as if a film on the surface were supporting the razor blade right on top of the water.

If we were to reduce the surface tension, the razor blade floating on the surface would no longer float.

How can we reduce surface tension? We can do so by reducing the strength of the attraction of the water molecules at the surface. When the water molecules are no longer held together strongly, the surface tension will be reduced. How can we do this?

If Bob were to put some detergent into the water, it would reduce the attraction of all the water molecules including the ones at the surface. Anything that was floating on the surface would no longer have a film on which to float and would sink to the bottom.

Let's see if Paul can float a piece of steel wool on water. The steel wool is heavier than water and yet it floats. Can we make it sink?

Let's see what happens when _____ pours a little detergent into the water. The steel wool now sinks to the bottom. Why?

The water molecules at the surface were held together strongly and formed a film at the surface. It was the film that supported the steel wool. When _____ poured detergent into the water -- the attraction of molecules weakened and the surface tension was reduced letting the steel wool sink to the bottom.

Here's some talcum powder which is much lighter in weight than the steel wool. It too can float on the surface. What will happen to it if _____ pours detergent into the water?

<u>Incomplete</u>: Will the powder which is very light in weight still float or will it sink? You can try this at home and find out whether the powder will float or sink a after you add detergent.

HAMMER AND RUBBER BAND

This piece of string tied to the nail on the hammer supports the entire weight of the hammer, doesn't it? It is as if the weight of the hammer were a downward force like this and the string supports it because it exerts an equal force that is opposite like this.

Suppose two strings were tied to the hammer like this. How much of the hammer's weight is supported by each string? Each string supports just half the weight of the hammer. The upward force is divided between the two strings. Let's try this with a rubber band and measure the pull. Here's _____ holding a hammer with a pulley attached to it. Suppose _____ attaches a string to a rubber band, and now fastens the rubber band to a nail here on this support, then runs the string around the pulley on the hammer. The string can slide over the pulley. Now as _____ attaches the other end of the string to this frame, both the rubber band and the string support the weight of the hammer.

We can think of this as two forces now, like this: one exerted by the rubber band, the other by the string, and their result is an equal and opposite upward force to the hammer's weight or downward force. The weight of the hammer exerts a downward force. Half that force is taken up by the string; the other half is taken up by the rubber band. That part of the total force that is exerted on the rubber band causes the rubber band to stretch. It has stretched _____ inches. More pull -- more stretch; less pull -- less stretch. The amount of stretch in the rubber band indicates the amount of pull on this side.

Now, _____ suppose you take the end of the string away from the frame and tie it to the nail on the hammer. How much will the rubber band stretch? Will it stretch as much as before? Will it stretch more; or will it stretch less? Tie the string to the hammer and see.

The rubber band stretches _____ inches or twice as much, because it is supporting all the weight of the hammer now.

Try checking this result yourself at home.

POLAROID LENSES AND LIGHT

Here is a long rope. See it wiggle as _____ moves it up and down. These wiggles look like <u>waves</u>. We can make the <u>waves</u> on the rope go not only up and down but sideways also. Look: _____ can make the waves go in any direction.

_____ is holding a piece of stiff cardboard with a long slot in it. _____ holds it so the slot is vertical. Now _____ passes the rope through the slot. Now we wiggle the string vertically. Look at the waves move down the rope to the slot and out to the other end of the rope.

We can make the waves travel to the end of the rope as long as the direction of the slot matches the direction of the waves.

See what happens, now, though: the slot is turned horizontally but the rope is wiggled vertically. See? The waves go to the slot but no waves come out on the other side.

Only when the direction of the slot and the direction of the waves match, can the waves get through.

Let's wiggle the rope through two slots. Here both slots run vertically. When we make waves also vertically they get through. But no horizontal waves get through -- unless we turn both slots horizontally.

Now watch as we turn one slot so it is at right angles to the other. See what happens. Neither the waves up and down nor the waves back and forth get all the way through to the end of the rope. The vertical waves get through the first slot because it's vertical but are stopped at the second slot because the slot is horizontal.

This is a piece of polaroid glass. Some of you remember seeing polaroids, like on polaroid sun glasses, don't you? Here is one. Polaroids are transparent. We can see through them. They are peculiar transparent materials, however, because they pass light waves of only one direction. Just like the slots let waves of only one direction pass.

You see. We can imagine that the light is like the rope, the light waves like the rope waves, and the polaroids like the slots.

Remember what happened when we vibrated the rope through two slots? Let's find out whether we can see through polaroid films when we turn them in different directions. When _____ holds one polaroid film up in a vertical direction you can see his face, can't you? What will happen if _____ holds a second polaroid film in front of the first one? But he'll hold the second film in a horizontal direction. What will happen? That's right; now you can't see his face.

The first film oriented the light in a vertical direction. The second film was oriented horizontally and therefore no light could come through.

You can find out what happens by trying it at home - if you turn polaroid films in different directions.

MARBLES AND ENERGY WAVES

Have you ever noticed what happens when a pebble is dropped into a still pool of water? No doubt you remember how waves are formed. Have you ever thought about what a wave is?

Let's show what happens when a pebble is dropped into a pool of water. Waves grow from the point where the pebble is dropped. These are water waves. A water wave is a disturbance on the surface of the water causing it to go up and down. There are other kinds of waves besides up and down waves. There are waves that travel back and forth or sideways. They can travel through gases, liquids, and solids. For example, they can travel through solids like these marbles. We can use these marbles to show how waves travel through a solid such as glass. If _____ rolls a marble, it will hit this first one in the row, and it will do approximately what the pebble did to the water it touched as it fell in the pool.

When the moving marble strikes the first marble, it gives the first marble a tiny squeeze or compression. We say that the moving marble compresses the first one. This squeezed-up or compressed marble then compresses the second; the second the third; and so on. A compression travels along the row. The next instant after the compression

or squeezing, the marbles stretch out again beginning with the first. Instead of being compressed they become stretched out or relaxed which is just the opposite of the compression or squeezing.

The moving marble gave nearly all its energy to the first one it hit, and then it stood still. The first marble that was hit passed the energy to the second and so on all down the line, and none moved except the last one. The last one had no marble to pass the energy on to, and so it bounced off. It bounced off with nearly as much speed as the moving marble at the other end. This way neither the energy nor the speed of the moving marble was lost. It all passed on to the last marble.

Here is a puzzle for you to try to solve. What will happen if _____ takes <u>two</u> marbles and rolls them against the row of marbles? What will happen at the other end? The two marbles hitting caused two marbles to shoot off at this end which _____ stopped. What if _____ were to do the same thing with three marbles, or with four? See if you can guess.

How will both the energy and the speed of the moving marbles pass down the row and what will it do to the marbles at the other end? The three marbles caused three at the other end to shoot off.

You can try different numbers and speeds at home and check this yourself.

HOT WATER BOTTLE AND AIR PRESSURE

Will this chair support the weight of all these books that _____ and _____ are putting on it. Of course it does. What about this cardboard box? Will it support the weight of the same books?

We all know that gravity is a force which pulls all objects toward the earth unless they are supported by an upward force that is equal to their weight. The chair exerted an upward force that was at least equal to the downward force exerted by the books which weigh _____ pounds. But the cardboard box exerted an upward force less than the weight of the books and they fell to the floor.

What about this hot water bottle into which _____ will blow some air. Do you think it will be able to support the weight of all those heavy books?

Let's consider a principle known as <u>Pascal's Law</u>, which will help us make up our minds whether a hot water bottle might be able to exert an upward force which will be equal to and therefore support the weight of the books which exerts a downward force. Pascal's Law goes something like this. If a gas like air is confined in some kind of container like the hot water bottle and is then subjected to pressure, the pressure is transmitted equally to every part of the inside of the container. If _____ were to blow air into the hot water bottle through this tube, only a little amount of pressure is needed to support weights. That's because the pressure from this little opening is spread equally inside the hot water bottle. The pressure at any point in the hot water bottle is equal. The pressure is equal here, here, and here. That's what Pascal's Law states.

But since the pressure is spread out equally over this entire surface area of the hot water bottle, the amount of upward force that the hot water bottle can exert is very large. Force is equal to pressure x area. The bigger the area that an equal pressure is spread over, the greater force it will exert. It can therefore support

large weights.

_____ put some heavy books on the hot water bottle as _____ blows air into it. You can see the hot water bottle supports their weight.

Pressure on a confined gas is spread out equally in all directions and if it is spread out over a large area it creates a large force. That upward force will support the downward force of the heavy books.

But is the upward force big enough to support the weight of <u>all these</u> books? Remember all these books weigh _____ pounds. Do you think the hot water bottle can support them all?

Why not try this at home and find out.

These students found these experiments easy and fun to do. Why don't <u>you</u> try some of them at home.

FUN DAY

Script for Control Lesson
(Adult Demonstrator)

Today we're going to show you six interesting experiments. The experiments are fun to do and easy enough to do yourself at home.

I'm going to explain each experiment and then I'll show you how easy the experiment is to do and how you can do them at home.

MAGNETS AND IRON FILINGS

Here is a magnet. You have no doubt seen magnets such as this one, and know that they attract iron and steel. Magnets will not strongly attract anything which is not made of iron or steel. One end of the magnet is called the north pole and the other is called the south pole. If we bring the north pole of one magnet near another magnet it will attract the south pole of the other magnet. A force pulls the north pole and the south pole together. If we bring two north poles together or two south poles together, they will not attract each other. Instead, they will repel each other. That is, there will be a force between them pushing them apart. A basic principle of magnetism, then is this: like poles attract and unlike poles repel. Another principle is that the magnetism of a magnet is strongest at its poles and gets weaker and weaker as one moves nearer and nearer to the middle.

We can show this by dipping a magnet into some carpet tacks made of iron. When we take the magnet out, most of the tacks that have stuck to the magnet are stuck near the poles. Only a very few of the tacks are stuck near the middle of the magnet. Most of the tacks stick where the magnetism is strongest, near the poles, and only a few stick where the magnetism is weakest, near the middle.

The magnetic force of a magnet extends out into the space around it in a definite pattern. We can use iron filings to show this pattern.

Let's put a piece of paper over a magnet. Let's sprinkle a thin layer of iron filings on it. Let's gently tap the paper. The iron filings arrange themselves in rows, stretching out from each pole. Notice also how these rows run from one pole to the other along the sides. The iron filings arrange themselves in rows along the magnetic lines of force. The fact that the rows of iron filings run from the north pole to the south pole shows that magnetic lines of force connect these two poles.

Magnetic lines of force also connect unlike poles of two different magnets. We can show this by using two magnets, with the north pole of one facing the south pole of the other, like this. Now when we sprinkle iron filings on a piece of paper over two magnets with opposite poles close together we get a pattern like this. Notice how the lines of force run from the north pole of the first magnet to the south pole of the other. Lines of force connect these poles because they are unlike and therefore attract each other.

Suppose we were to turn one of the magnets around so that the two poles facing each other are alike, this way. What pattern will the iron filings show now? Will it be the same as before or different?

It is different. The magnetic lines of force go in the opposite direction

and the iron filings follow these new magnetic lines of force.

You can try various combinations yourself at home to see how iron filings arrange themselves around magnets.

FLOATING STEEL WOOL

We all know that objects that are heavier than water will generally sink to the bottom when we put them in water. But have you ever seen anything heavier than water float on the surface of the water? Here's a razor blade floating on the surface -- right on top of the water. The razor blade is heavier than water. How can it float right on top this way? What is the explanation?

We can go back to some of the ideas we learned about the make-up of matter. Remember that all matter is made up of molecules which are attracted to one another. Liquids, solids, and gases are all made up of molecules which are held together.

The molecules in the water in the beaker are held together very strongly. The attraction among the water molecules at the surface is so strong that it's almost as if a thin film were spread along the surface. This thin film at this surface acts as if it were under tension. We call this surface tension. It is the surface tension of the water that allows the razor blade to float on the surface. It's almost as if a film on the surface were supporting the razor blade right on top of the water.

If we were to reduce the surface tension, the blade floating on the surface would no longer float right on top. How can we reduce surface tension? We can do so by reducing the strength of the attraction of the water molecules at the surface. When the water molecules are no longer held together strongly, the surface tension will be reduced. How can we do this?

If we were to put some detergent into the water, it would reduce the attraction of all the water molecules including the ones at the surface. Anything that was floating on the surface would no longer have a film on which to float and would sink to the bottom.

Let's see if we can float this piece of steel wool on water. The steel wool is heavier than water and yet it floats. Can we make it sink?

Let's pour a little detergent into the water and see. The steel wool now sinks to the bottom. Why? The water molecules at the surface were held together strongly and formed a film at the surface. It was the film that supported the steel wool. When we poured detergent into the water -- the attraction of molecules weakened and the surface tension was reduced letting the steel sink to the bottom.

Here's talcum powder which is much lighter in weight than the steel wool. It too can float on the surface. What will happen to it if we pour detergent into the water?

Complete: There -- the powder which is so light in weight nevertheless sank to the bottom when we poured detergent in the water. The detergent reduced the attraction between water molecules including the ones at the surface, and therefore the film at the surface no longer supported the powder.

You can check this and see for yourself at home, if the powder really sinks when you add detergent.

HAMMER AND RUBBER BAND

This piece of string tied to the nail on the hammer supports the entire weight of the hammer, doesn't it. It is as if the weight of the hammer were a downward force like this, and the string supports it because it exerts an equal force that is opposite like this.

Suppose two strings were tied to the hammer like this. How much of the hammer's weight is supported by each string? Each string supports just half the weight of the hammer. The upward force is divided between the two strings.

Let's try this with a rubber band and measure the pull. Here's a hammer with a pulley attached to it. Let's attach a string to the rubber band and let's fasten the rubber band to a nail here on this support. Let's run the string around the pulley on the hammer. The string can slide over the pulley. Now as I attach the other end of the string to this frame, both the rubber band and the string support the weight of the hammer.

We can think of this as two forces now, like this, one exerted by the rubber band, the other by the string, and their result is an equal and opposite upward force to the hammer's weight or downward force.

The weight of the hammer exerts a downward force. Half that force is taken up by the string; the other half is taken up by the rubber band. That part of the total force that is exerted on the rubber band causes the rubber band to stretch. It has stretched _____ inches. More pull -- more stretch; less pull -- less stretch. The amount of stretch in the rubber band indicates the amount of pull on this side.

Now, suppose I take the end of the string away from this frame and tie it to the nail on the hammer. How much will the rubber band stretch? Will it stretch as much as before? Will it stretch more; or will it stretch less? Let's tie the string to the hammer and see.

The rubber band stretches _____ inches or twice as much, because it is supporting all the weight of the hammer now.

Try checking this result yourself at home.

POLAROID LENSES AND LIGHT

Here is a long rope. See it wiggle as we move it up and down. These wiggles look like <u>waves</u>. We can make the <u>waves</u> on the rope go not only up and down but sideways also. Look. I can make the waves go in any direction.

Here is a piece of stiff cardboard with a long slot in it. Let's hold it so the slot is vertical. Let's pass the rope through the slot. Now I wiggle the string vertically. Look at the waves move down the rope to the slot and out to the other end of the rope.

I can make the waves travel to the end of the rope as long as the direction of the slot matches the direction of the waves. See what happens, now, though. I turn the slot horizontally but the rope is wiggled vertically. See? The waves go to the slot but no waves come out on the other side.

Only when the direction of the slot and the direction of the waves match, can the waves get through.

Let's wiggle the rope through two slots. Here both slots run vertically. When we make waves also vertically they get through. But no horizontal waves get through -- unless we turn both slots horizontally.

Now watch me turn one slot so it is at right angles to the other. See what happens. Neither the waves up and down nor the waves back and forth get all the way through to the end of the rope.

The vertical waves get through the first slot because it's vertical but are stopped at the second slot because the slot is horizontal.

Here is a piece of polaroid glass. Some of you remember seeing polaroids, like on polaroid sun glasses, don't you? Here is one. Polaroids are transparent. We can see through them. They are peculiar transparent materials, because they pass light waves of only one direction. Just like the slots let waves of only one direction pass.

You see, we can imagine that the light is like the rope, the light waves like the rope waves, and the slots like the polaroids.

Remember what happened when we vibrated the rope through two slots? Let's find out whether we can see through polaroid lenses when we turn them in different directions. When I hold one polaroid lens up in a vertical direction you can see my face, can't you? What will happen if I hold a second polaroid lens in front of the first one? But I'll hold the second lens in a horizontal direction. What will happen? That's right, now you can't see my face.

The first lens oriented the light in a vertical direction. The second lens was oriented horizontally and therefore no light could come through. What will happen now if I orient the second one vertically, the same direction as the first one? That's right, when they're in the same direction you can see my face.

You can try this at home by turning lenses in different directions and see what happens.

MARBLES AND ENERGY WAVES

Have you ever noticed what happens when a pebble is dropped into a still pool of water? No doubt you remember how waves are formed. Have you ever thought about what a wave is?

Let's show what happens when a pebble is dropped into a pool of water. Waves grow from the point where the pebble is dropped. These are water waves. A water wave is a disturbance on the surface of the water causing it to go up and down.

There are other kinds of waves beside up and down waves. There are waves that travel back and forth or sideways. They can travel through gases, liquids, and solids. For example, they can travel through solids like these marbles. We can use these marbles to show how waves travel through a solid such as glass. If a marble hits this first one in the row, it will do approximately what the pebble did to the water it touched as it fell in the pool.

When the moving marble strikes the first marble it gives the first marble a tiny squeeze or compression. We say that the moving marble compresses the first one. This squeezed-up or compressed marble then compresses the second; the second the third; and so on. A compression travels along the row. The next instant after the compression or squeezing, the marbles stretch out again beginning with the first. Instead of being compressed, they become stretched out or relaxed which is just the opposite of the compression or squeezing.

The moving marble gave nearly all its energy to the first one it hit, and then it stood still. The first marble that was hit passed the energy to the second and so on all down the line, and none moved except the last one. The last one had no marble to pass the energy on to, and so it bounced off. It bounced off with nearly as much speed as the moving marble at the other end. This way neither the energy nor the speed of the moving marble was lost. It all passed on to the last marble.

Here is a puzzle for you to try to solve. What will happen if we take two marbles and roll them against the row of marbles? What will happen at the other end? The two marbles hitting caused two marbles to shoot off at this end. What if we were to do the same thing with three marbles, or with four? See if you can guess.

How will both the energy and the speed of the moving marbles pass down the row and what will it do to the marbles at the other end? The three marbles caused three at the other end to shoot off. You can try different numbers and speeds at home and check this yourself.

HOT WATER BOTTLE AND AIR PRESSURE

Will this chair support the weight of all these books? Of course it does. What about this cardboard box? Will it support the weight of the same books?

We all know that gravity is a force which pulls all objects toward the earth unless they are supported by an upward force that is equal to their weight. The chair exerted an upward force that was at least equal to the downward force exerted by the books which weigh _____ pounds. But the cardboard box exerted an upward force less than the weight of the books and they fell to the floor.

What about this hot water bottle into which I will blow some air? Do you think it will be able to support the weight of all those heavy books?

Let's consider a principle known as Pascal's Law, which will help us make up our minds whether a hot water bottle might be able to exert an upward force which will be equal to and therefore support the weight of the books which exerts a downward force.

Pascal's Law goes something like this. If a gas like air is confined in some kind of container like the hot water bottle and is then subjected to pressure, the pressure is transmitted equally to every part of the inside of the container. If I were to blow air into the hot water bottle through this tube, only a little amount of pressure is needed to support weights. That's because the pressure from this little opening is spread equally inside the hot water bottle. The pressure at any point in the hot water bottle is equal. The pressure is equal here, here, and here. That's what Pascal's Law states.

But since the pressure is spread out equally over this entire surface area of the hot water bottle, the amount of upward force that the hot water bottle can exert is very large. Force is equal to pressure times area. The bigger the area that an equal pressure is spread over, the greater force it will exert. It can therefore support large weights.

Let's put some heavy books on the hot water bottle as I blow air into it. You can see the hot water bottle support their weight. Pressure on a confined gas is spread out equally in all directions and if it is spread out over a large area it creates a large force. That upward force will support the downward force of the heavy books.

Is the upward force big enough to support <u>all these</u> books which weigh about _____ pounds? Let's see. Yes it can. The pressure spread out over the large area of the hot water bottle exerted an upward force that was at least equal to the downward force that the heavy books exerted and it was able to support them.

You can try this at home to see that a hot water bottle will in fact support several heavy books.

APPENDIX B

QUESTIONNAIRES TO MEASURE EFFECTS OF THE FUN DAY PROGRAM

Fun Day Experiments

1. Before and After Measures of Interest in Science
   a. preference questionnaire pp. B- 2 - B- 8

2. Form for Nominating Favorite Experiments pp. B- 9 - B-10

3. Questionnaire on Extracurricular Activities pp. B-11 - B-13

FUN DAY

Preference Questionnaire

Form Girl

Name _____ Grade _____ (7th or 8th)

School _____ Boy ____ Girl ____

PART I: 6 minutes

Instructions: Below are several sets of five occupations. Study each set of occupations and pick out the one you would most like to be when you grow up. Put a 1 beside your first choice. Then pick out your second choice and put a 2 beside it. Put the numbers 3, 4, and 5 beside your third, fourth and fifth choices.

Example: Let's do an example together. Here's a set of 5 occupations:

____ doctor

____ movie director

____ teacher

____ poet

____ clerk in a store

Pick the one you would most like to be. Put a 1 next to it. Pick your second choice. Put a 2 next to it. Pick your third choice. Put a 3 next to it. Pick your fourth choice. Put a 4 next to it. Pick your fifth or last choice (the one you would least like to be) and put a 5 next to it.

Go ahead and make your choices among each set of occupations on the next page.

1. _____ Chemistry Teacher
_____ English Teacher
_____ Movie Star
_____ Secretary
_____ Musician

2. _____ Foreign Language Teacher
_____ Physics Teacher
_____ Writer of Children's Books
_____ Sales Clerk
_____ Stenographer

3. _____ Home Economics Teacher
_____ Artist
_____ Biology Teacher
_____ Occupational Therapist
_____ Nurse

4. _____ Librarian
_____ Music Teacher
_____ Social Worker
_____ Medical Lab Technician
_____ Grade School Teacher

5. _____ Art Teacher
_____ Hospital Dietician
_____ Airline Hostess
_____ Clothes Designer
_____ General Science Teacher

6. _____ Chemist
_____ Receptionist
_____ Singer
_____ Kindergarten Teacher
_____ Telephone Operator

7. _____ Hairdresser
_____ Writer of Popular Science
_____ Interior Decorator
_____ Clothes Model
_____ Dancer

PART II: 14 minutes

Instructions: Below are several pairs of things boys and girls your own age might like to do. Pick out the one in each pair that you would prefer to do, and put a check mark next to it.

Example: Let's do an example together. Here's one pair of things you might do.

_____ go to the movies
_____ collect coins

Pick the one you would prefer to do. Put a check mark ✓ next to it. Do the same for each of the pairs below. Pick the one activity in each pair you prefer and put a check mark next to it.

1. _____ read a mystery story
   _____ read a science fiction story

2. _____ read a book about Abraham Lincoln
   _____ read a book about Thomas A. Edison

3. _____ visit an atomic energy plant
   _____ go on a picnic with some friends

4. _____ visit a factory to see how TV sets are made
   _____ watch a football game

5. _____ receive a portable phonograph set as a gift
   _____ receive a chemistry set as a gift

6. _____ listen to records of your own choice
   _____ build a crystal set

7. _____ read an article on how the human brain works
   _____ read an article about life in Hollywood

8. _____ see a movie about a trip to the moon
   _____ see a movie about hunting and trapping big game in Africa

9. _____ start a stamp collection
   _____ start a scrapbook on rockets and space travel

10. _____ watch a show of magic tricks and hypnotism
    _____ visit a chemistry research laboratory

11. _____ get up in the middle of the night to see an eclipse of the moon
    _____ go for a walk to take pictures on a pretty day

12. _____ join a club which builds radios and other electrical things
    _____ join a basketball team that plays other teams

13. _____ start a scrapbook about movie stars
    _____ start a nature collection (leaves, insects, rocks, etc.)

14. _____ meet a famous scientist
    _____ meet a famous baseball player

15. _____ visit a museum of natural science
_____ visit an arts and crafts museum

16. _____ see a play about the life of George Washington
_____ see a play about how the Wright brothers built the first airplane

17. _____ go to a lecture on space travel
_____ go to a lecture on Hawaii, illustrated with colored slides

18. _____ see a movie about the U. S. Marines
_____ see a movie about how a scientist develops a cure for a dread disease

19. _____ write an essay on the solar system
_____ write a story about a dog who was faithful to his master

20. _____ go to summer camp for a month
_____ go along on a geology field trip which lasts a month

PART III

Here is another set of occupations. This time there are seven of them. Put a 1 next to the one you would most like to be; a 2 next to your second choice; a 3 next to your third choice; and so on until you put a 7 next to the one you would least like to be.

_____ Chemistry Teacher
_____ Physics Teacher
_____ Biology Teacher
_____ Medical Lab Technician
_____ General Science Teacher
_____ Chemist
_____ Writer of Popular Science

FUN DAY

Preference Questionnaire

Form Boy

Name _____ Grade _____

School _____ 7th or 8th

Boy _____ Girl _____

PART I: 6 minutes

Instructions: On the next page are several sets of five occupations. Study each set of occupations and pick out the one you would most like to be when you grow up. Put a 1 beside your first choice. Then pick out your second choice and put a 2 beside it. Put the numbers 3, 4, and 5 beside your third, fourth, and fifth choices.

Example: Let's do an example together. Here's a set of 5 occupations.

_____ doctor

_____ movie director

_____ teacher

_____ poet

_____ clerk in a store

Pick the one you would most like to be. Put a 1 next to it. Pick your second choice. Put a 2 next to it. Pick your third choice. Put a 3 next to it. Pick your fourth choice. Put a 4 next to it. Pick your fifth or last choice (the one you would least like to be) and put a 5 next to it.

Go ahead and make your choices among each set of occupations on the next page.

1. _____ Chemist
_____ Jet Pilot
_____ Accountant
_____ Artist
_____ Carpenter

2. _____ Baseball Player
_____ Astronomer
_____ Business Executive
_____ Writer
_____ Railroad Conductor

3. _____ Army Officer
_____ Lawyer
_____ Inventor
_____ Movie Star
_____ Dentist

4. _____ Forest Ranger
_____ Salesman
_____ Musician
_____ Physicist
_____ Ship Captain

5. _____ Policeman
_____ Politician
_____ History Teacher
_____ Banker
_____ Mechanical Engineer

6. _____ Electrical Engineer
_____ FBI Agent
_____ Athletic Coach
_____ Clergyman (Minister, Rabbi, or Priest)
_____ Farmer

7. _____ Newspaper Reporter
_____ Mathematician
_____ Explorer
_____ Cartoonist
_____ Architect

PART II
(Same as Girl Form)

PART III

Here is another set of occupations. This time there are seven of them. Put a 1 next to the one you would most like to be; a 2 next to your second choice; a 3 next to your third choice; and so on until you put a 7 next to the one you would least like to be.

____ Chemist

____ Astronomer

____ Inventor

____ Physicist

____ Mechanical Engineer

____ Electrical Engineer

____ Mathematician

Immediate Post-Measure of Interest in Particular Experiments

Name _____

School _____

Grade Level _____
7th or 8th

Vote for your Favorite Experiments

Below is a list of the six experiments you just saw. If you had everything you needed to do them, which experiment would you like most to do yourself? Pick out the one you would most like to do at home and put a 1 beside it. Now pick out your second choice and put a 2 beside it. Put numbers 3, 4, and 5 beside your third, fourth, and fifth choices. Finally, put a 6 beside the experiment you would least like to do at home.

_____ Hot Water Bottle and Air Pressure

_____ Marbles and Energy Waves

_____ Polaroid Lenses and Light

_____ The Hammer and the Rubber Band

_____ Floating Steel Wool

_____ Magnets and Iron Filings

Why did you pick the experiment you did as the one you most want to do?

Why did you pick the experiment you did as the one you least want to do?

Maybe you are very much interested in doing more than one of the experiments. Place a check mark ✓ in <u>one</u> of the columns to tell how much you would like to do <u>each</u> of the six experiments at home.

Be sure to put only <u>one</u> check mark on each row.

Be sure that <u>every</u> row has a check mark.

Check the box for each experiment that tells how much you are <u>really</u> interested. Your answers will be kept confidential and will <u>not</u> affect your school grades in any way.

	Would like very much to do	Would be fairly much interested	Would have a little interest in doing	Would not be interested	Would not like to do it
Hot Water Bottle and Air Pressure					
Marbles and Energy Waves					
Polaroid Lenses and Light					
The Hammer and the Rubber Band					
Floating Steel Wool					
Magnets and Iron Filings					

FUN DAY

Delayed Post-Measure of Experiments Undertaken at Home

WQED

Junior High School Science

School _____ Name _____

Grade Level _____
7th or 8th

1. During the last month, which Junior High School Science TV program did you enjoy most?

1a. What was the one thing you liked best about this program?

2. A couple of weeks ago you saw a TV program in class in which six easy experiments were shown. Did you do any of these experiments at home?

Please check one Yes, I did ____ No, I didn't ____

I don't remember ____

2a. If yes, which one did you do?

2b. What results did you get?

2c. Why did you decide to do this experiment rather than some other one?

3. Did you try any others of the six experiments?

Yes ____ No ____ If yes, which one? _____

3a. What were the results?

4. What was the one thing you liked best about this TV program (the one with the six experiments)?

5. What was the one thing you really didn't like about the program?

6. How would you compare this program with the other Junior High School Science programs you regularly watch?

Check one

I LIKED IT VERY MUCH MORE	I LIKED IT SOME-WHAT MORE	I LIKED IT AS MUCH	I LIKED IT LESS	I DIDN'T LIKE IT

7. Please indicate <u>how well you remember</u> each program that was shown in April by placing a check mark ✓ in the appropriate column.

Be sure to put only <u>one</u> check mark in each row.

Be sure to put a check mark on <u>every</u> row.

	Remember it very clearly	Remember it fairly well	Don't remember it too well	Don't remember seeing it
Cause, Carrier, & Speed of Sound				
Travel & Reflection of Sound				
Volume, Pitch, & Quality of Sound				
Musical Instruments				
Hearing & the Human Ear				
Morse's Telegraph				
Six Easy Experiments				
The Telephone				
Bell Telephone Demonstration				
The Electron Tube				
The Wireless				
Transistors				

8. Please indicate how interesting you thought each of the following Junior High School Science programs was.

First look over the list and find the program you thought most interesting. Put a 1 next to it. Now put a 2 next to the one you thought was next most interesting. Now put a 3 next to your third choice and 4 next to your fourth choice and so on until you have put a number next to all the programs.

For any program you didn't see or don't remember, just put a zero (0) next to it.

_____ Cause, Carrier, & Speed of Sound

_____ Travel & Reflection of Sound

_____ Volume, Pitch, & Quality of Sound

_____ Musical Instruments

_____ Hearing & the Human Ear

_____ Morse's Telegraph

_____ Six Easy Experiments

_____ The Telephone

_____ Bell Telephone Demonstration

_____ The Electron Tube

_____ The Wireless

_____ Transistors

APPENDIX C

Science Kits

1. Materials and Instructions pp. C-2 - C-13

WQED

JUNIOR HIGH SCHOOL SCIENCE

Experiment No. 1

Instructions for Magnets and Iron Filings Experiment

Explanation

You can use the materials in this kit to demonstrate a fundamental principle of magnetism. The principle is that the magnetic force of a magnet extends into the space surrounding it. This magnetic field, as it is called, consists of a pattern of invisible lines of force. Even though these lines of force are invisible, you can show what the pattern looks like with iron filings. You can show that opposite magnetic poles, which attract each other, are connected by these lines of force. And you can also show that magnetic poles of the same kind, which repel each other, are not connected by lines of force.

Materials in this Kit

a) two bar magnets
b) a container of iron filings
c) a stiff sheet of white paper

Steps to Follow to Perform the Experiment

Now follow each step described below.

1. Place the two magnets on a smooth table with the north pole of one facing the south pole of the other.

   (Diagram)

   Place them as close together as it is possible without them moving together.

2. Place the sheet of paper over the magnets.

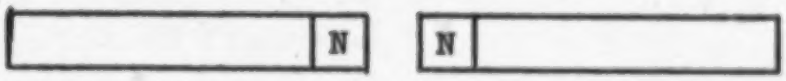
3. Slowly sprinkle some of the iron filings over the paper. Sprinkle them evenly over the paper until the pattern of the lines of force can be clearly seen. It will help if you gently tap the sheet of paper on the edge a few times.

   Notice how the iron filings arrange themselves along the lines of force connecting the two opposite poles.

4. Now draw a picture of the pattern the iron filings have made. Use the space provided at the end of these instructions.

5. Now, carefully lift the sheet of paper off the magnets. Bend the paper (without creasing it) so that you can put all of the iron filings back into the container without spilling any.

6. Turn one of the magnets around -- it doesn't matter which one -- so that two like poles, either two north poles or two south poles, face each other.



Place the magnets as close together as the force between them will allow.

7. Now place the sheet of paper over the magnets again, and sprinkle iron filings over it as before. Tap the edge of the paper a few times, if necessary.

Notice how the pattern differs from the one you had before. See how the lines of force coming out from the two like poles do not connect but, instead, turn away from each other.

8. Now draw a picture of this pattern next to the first picture you drew.

Results

1. Draw a picture here of the lines of force that appeared when you placed opposite poles near each other.

2. Draw a picture here of the lines of force that appeared when you placed like poles near each other.

3. What is the difference between them?

WQED

JUNIOR HIGH SCHOOL SCIENCE

Experiment No. 2

Instructions for Floating Steel Wool Experiment

Explanation

You can use the materials in this kit to demonstrate a principle about liquids. The principle is that the molecules of a liquid attract one another. This is true both for the molecules beneath the surface and for the molecules on the surface. The attraction among the molecules on the surface of the liquid is called the surface tension of the liquid. Surface tension allows some objects which are a little bit heavier than the liquid to float on top of it. If we were to float a razor blade on top of a pan of water, for example, it would be the surface tension of the water which would keep the razor blade from sinking. The weight would not be quite enough to break through the attraction of the molecules on the surface for one another. If we were then to add anything to the water which reduced the surface tension, the razor blade would sink.

Materials in this Kit

a) one piece of steel wool
b) an envelope containing some powder
c) a small bottle of detergent
d) an eye dropper

Steps to Follow to Perform the Experiment

Now follow each step described below.

1. Take a glass bowl and pour two or three cups of water into it. Let the water stand long enough for the surface to become smooth.
2. Place the piece of steel wool gently on the surface of the water.

   Steel is heavier than water, but the steel wool floats because the surface tension of the water holds it up.

3. Now open the bottle of detergent and pour several drops of the detergent into the water.

   This detergent, like other detergents such as some brands of shampoo and liquid "soaps," reduces the surface tension of water. With the molecules at the surface no longer strongly attracting one another, the weight of the steel wool is sufficient to break through the surface of the water.

4. Empty the water from the bowl and rinse it out. Put the same amount of fresh water into it, and wait until the surface becomes smooth.

5. Open the envelope and pour some of the powder onto the surface of the water.

   The powder, like the steel wool, floats on the water.

6. Now pour several drops of the detergent into the water.

   Notice how the powder sinks. As before, the detergent reduces the surface tension of the water, thus weakening the attractive force between the water molecules on the surface. This allows the weight of the powder particles to break through, and the powder sinks.

Results

1. What happened when you put steel wool on the surface of the water and then you poured detergent into the water?

2. What happened when you put powder on the surface of the water and then you poured detergent into the water?

WQED

JUNIOR HIGH SCHOOL SCIENCE

Experiment No. 3

Instructions for Marbles and Energy Waves Experiment

Explanation

This kit can be used by you to demonstrate a basic principle of the transmission of energy by waves. The principle is that waves can travel through gases, liquids, or solids. For example, they can travel through objects made of glass, such as glass marbles. You can show how energy is passed along a row of marbles from one to the next.

Materials in this Kit

a) a bag containing eight glass marbles, all the same size
b) a felt-lined trough

Steps to Follow to Perform the Experiment

Now follow each step described below.

1. Bend the cardboard along the three creases so that it looks like an M when viewed from the end.
2. Place the creased cardboard on a smooth table, felt side up, and you have a trough. If the trough won't hold its shape, fasten a piece of scotch tape or adhesive tape across the bottom near each end.
3. Put the eight marbles in the trough. Place them close together so that each one touches the next one.
4. Now roll the marble at one end of the row a couple of inches away from the others. Give it a flick with your finger so that it rolls against the rest of the marbles.

   Notice how the energy you gave to the rolling marble is passed on through the row of marbles and is received by the marble at the other end. It bounces off with almost the same speed as the first marble had when it hit the second one.

5. Next, roll <u>two</u> marbles a couple of inches away from the other six. Give these two marbles a flick with your finger so that they roll against the others.

   This time <u>two</u> marbles bounced off the other end, instead of only one as before, and these had almost the same speed as the two marbles you flicked with your finger. This way no energy was lost. If only one marble had bounced off the other end with the same speed, energy would have been lost.

6. Try the experiment again, but roll <u>three</u> marbles against the rest.

   Now <u>three</u> marbles bounce off the other end with about the same speed, and again all the energy is transmitted by waves through the marbles. No energy is lost.

7. Try rolling <u>four</u> marbles against the other four.

   The first four pass on all their energy to the the other four, which bounce off at about the same speed.

8. Do the experiment once again, this time rolling <u>five</u> marbles against the remaining three.

   Notice how five marbles are still moving afterwards, at about the same speed, and again all the energy has been transmitted by waves through the marbles.

<u>Results</u>

1. What happened when <u>you</u> rolled:

   1 marble:

   2 marbles:

   3 marbles:

   4 marbles:

   5 marbles:

WQED

JUNIOR HIGH SCHOOL SCIENCE

Experiment No. 4

Instructions for Polaroid Lenses and Light Experiment

Explanation

You can use this kit to demonstrate a fundamental property of light. This property of light is that its waves vibrate in all directions. Even if the light is shining in one direction only, as with a beam of light, the vibration of the waves goes on in all directions. A polaroid film passes light waves of one direction of vibration only. Therefore we can use polaroid films to demonstrate this property of light.

Materials in this Kit

In this kit you should find two polaroid lenses. Check to see that you have both of these lenses in your kit.

a) two polaroid pieces of film

Steps to Follow to Perform the Experiment

Now follow each step described below.

1. Take one of your polaroid lenses and look through it.

   You will find that it is transparent - you can see through it. However, notice that things don't look quite as bright as they do without the lens. This is because it only lets through light waves which are vibrating in one direction.

2. Now look through the other polaroid lens.

   Things look just the same through this second lens as they did through the first one.

3. With the lenses in front of your face, look in the mirror.

   You can see yourself, can't you?

4. Put the two lenses together so that you can look through both of them at the same time. Hold one of the lenses with the arrow pointing to the side and the other with the arrow pointing up. Now look at the mirror.

   Notice now you don't see any light coming through and that you can't see yourself in the mirror.

5. Now turn the lenses so that both arrows are in the same direction. Now look in the mirror.

   Notice that now, light does come through and you can see yourself in a mirror.

Results

1. What happened when you held the polaroid lenses with the arrows pointing at right angles to each other?

2. What happened when you held the lenses with the arrows pointing in the same direction?

WQED

JUNIOR HIGH SCHOOL SCIENCE

Experiment No. 5

Instructions for the Hammer and Rubber Band Experiment

Explanation

You can use the materials in this kit to demonstrate a fundamental principle of mechanics. This principle states that, for any force there exists an equal and opposite force. For example, if a weight is hung by a rope, the rope exerts an upward force on the weight sufficient to keep it from falling, and -- likewise -- the weight exerts an equal but downward force on the rope.

Materials in this Kit

a) a piece of string with a rubber band inserted near one end
b) a plastic ruler
c) a hard rubber mallet, with a small pulley and a nail fastened to it

(BE CAREFUL ABOUT THE NAIL ON THE HANDLE)

Steps to Follow to Perform this Experiment

Now follow each step described below.

1. Find a towel rack of a convenient height.
2. Tie each end of the string (with the rubber band now forming part of the total length) to the crossbar of the towel rack. Fasten the two ends a few inches apart on the bar.
3. Now hang the mallet, head down, on the string by means of the pulley. The two halves of the string support the weight of the mallet. Measure the length of the rubber band, and write down this length.
4. Take the mallet off the string. From the towel rack, untie the end of string with the small loop, and put this end of the string over the small nail in the handle of the mallet.
5. Loop the string around the pulley and let the mallet hang, suspended by the single length of string.
6. Measure the length of the rubber band again and write down its length.

   Note that it has stretched to almost twice the length it had when both ends of the string were tied to the towel rack.

When both ends of the string were tied to the rack, the weight of the mallet was divided between the two parts of the string. The rubber band was only supporting half the weight of the mallet. When one end of the string was fastened to the mallet, the entire weight of the mallet was pulling on the rubber band. This caused it to stretch to almost twice the length as it did before.

Results

1. When you tied both ends of the rope to the towel rack, how many inches did the rubber band stretch? _____

2. When you tied one end to the nail on the hammer, how many inches did the rubber band now stretch? _____

WQED

JUNIOR HIGH SCHOOL SCIENCE

Experiment No. 6

Instructions for Hot Water Bottle and Air Pressure Experiment

Explanation

You can use the materials in this kit to demonstrate a fundamental principle of hydraulics known as Pascal's Law. Pascal's Law states that, if a gas is confined in a container and is then subjected to pressure, the pressure is transmitted equally to every part of the inside of the container. For example, if pressure is exerted on the air inside a hot water bottle by blowing more air into it, this pressure is exerted equally over all the inside parts of the hot water bottle.

Materials in this Kit

a) one rubber stopper with a hole in it
b) a glass rod inserted through the rubber stopper
c) a piece of rubber tubing fastened over the glass rod

Steps to Follow to Perform this Experiment

Now follow each step described below.

1. Borrow a hot water bottle from around the house.
2. Take the cap off the hot water bottle and insert the rubber stopper. Make sure the stopper is firmly in place.
3. Make sure the glass rod extends far enough into the rubber tubing so that they will not come apart.
4. Put the hot water bottle on the floor in a corner. Pile several books on top of the hot water bottle. It will be a good idea to lean them against the walls, so that they won't fall. The bigger and heavier the books, the better.
5. Now blow into the rubber tubing. Notice how easily the heavy stack of books is lifted. You don't have to blow very hard to lift them.

C A U T I O N: D O N ' T B L O W T O O M U C H A I R I N O R

Y O U M I G H T B R E A K T H E H O T W A T E R B O T T L E.

6. Now pile more books on top and blow air into the hot water bottle.

   The pressure produced when you blow into the tube is spread out equally over the

entire surface area of the hot water bottle. Because force is equal to pressure multiplied by area (F = MA), the total upward pressure exerted by the hot water bottle is quite large.

Results

1. What happened when you put several books on the hot water bottle and blew air into it?

2. What happened when you piled more books on and blew air into the hot water bottle?